Standard Operating Procedure

for

Routine Operation of the TEI Model 42CY NO_y Analyzer for Continuous Gas Concentrations of NO_y in CRPAQS

Prepared By:
Center for Environmental Research and Technology
College of Engineering
University of California
Riverside, CA 92521
(909) 781-5791
(909) 781-5790 fax

With Assistance By:
Beth Wittig
Sonoma Technology, Inc.
Petaluma, CA 94954
(707) 665-9900
(707) 665-9800 fax

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Dennis Fitz Date
Manager

John F. Collins Date
QA Coordinator

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1. SCOPE AND APPLICATION

This SOP describes procedures for routine operation of Thermo Environmental Model 42CY NO_y analyzers. The procedures are based on EPA Quality Assurance documentation (USEPA 1993; USEPA 1994) which should be referred to for general guidance. This SOP assumes that the operator is familiar with operation and calibration chemiluminescent analyzers for oxides of nitrogen. It focuses on the special requirements of NO_y analyzers as opposed to traditional NO_x analyzers.

2. SUMMARY OF METHOD

Figure 1 shows a schematic of the NO_y analyzer. The basic principle is chemiluminescent detection (CLD) of NO: Sample air is reacted with ozone in a low pressure reaction chamber. NO in the sample combines with ozone to form NO_2 and produces light (chemiluminescence) that is detected by a photomultiplier tube.

Ambient sample is first drawn through a short Teflon sample line and split into two parallel flow channels using a ½ inch PFA Teflon tee. Channel 1 passes through a Teflon filter and then directly to the detector. Channel 2 first passes through a catalytic converter before going through a Teflon filter to the detector. The catalytic converters reduce NO_2 and nitrate containing species in the sample to NO. Flow from each channel is alternately fed to the CLD to detect the NO. The converter is operated outside of the analyzer, close to the ambient sampling point. This allows for a short flow path upstream of the converter and minimizes the loss of species such as HNO_3. The signal detected on Channel 1 is called "NO" and on Channel 2 is called "NOy".

In addition to alternating flows from Channel 1 and Channel 2 to the reactor, the analyzer also alternates a flow of internal zero air, produced by pre-reacting the sample flow with a high concentration of ozone before reaching the CLD. The signal from this zero air stream is used to correct for analyzer drift, and allows the analyzer to achieve very low detection limits (0.05 ppb) compared with standard NO_x analyzers.

3. DEFINITIONS

$NO_x = NO + NO_2$. This is the parameter that would be measured by traditional NO_x analyzers if the catalytic converter reduced NO_2 to NO, but did not reduce other species to NO. In a traditional NO_x analyzer the catalytic converter does reduce other species to NO, but losses of these species throughout the sampling system is poorly controlled, and the conversion efficiency for these species is poorly known.

NO_y = NO plus all species capable of being reduced to NO in the catalytic converter of the analyzer. This includes NO_2, HNO_3, PAN, and alkylnitrates. It does not include nitro-compounds nor reduced nitrogen compounds such as ammonia.

NPN = n-propylnitrate. Used to test converter efficiency for alkylnitrates.

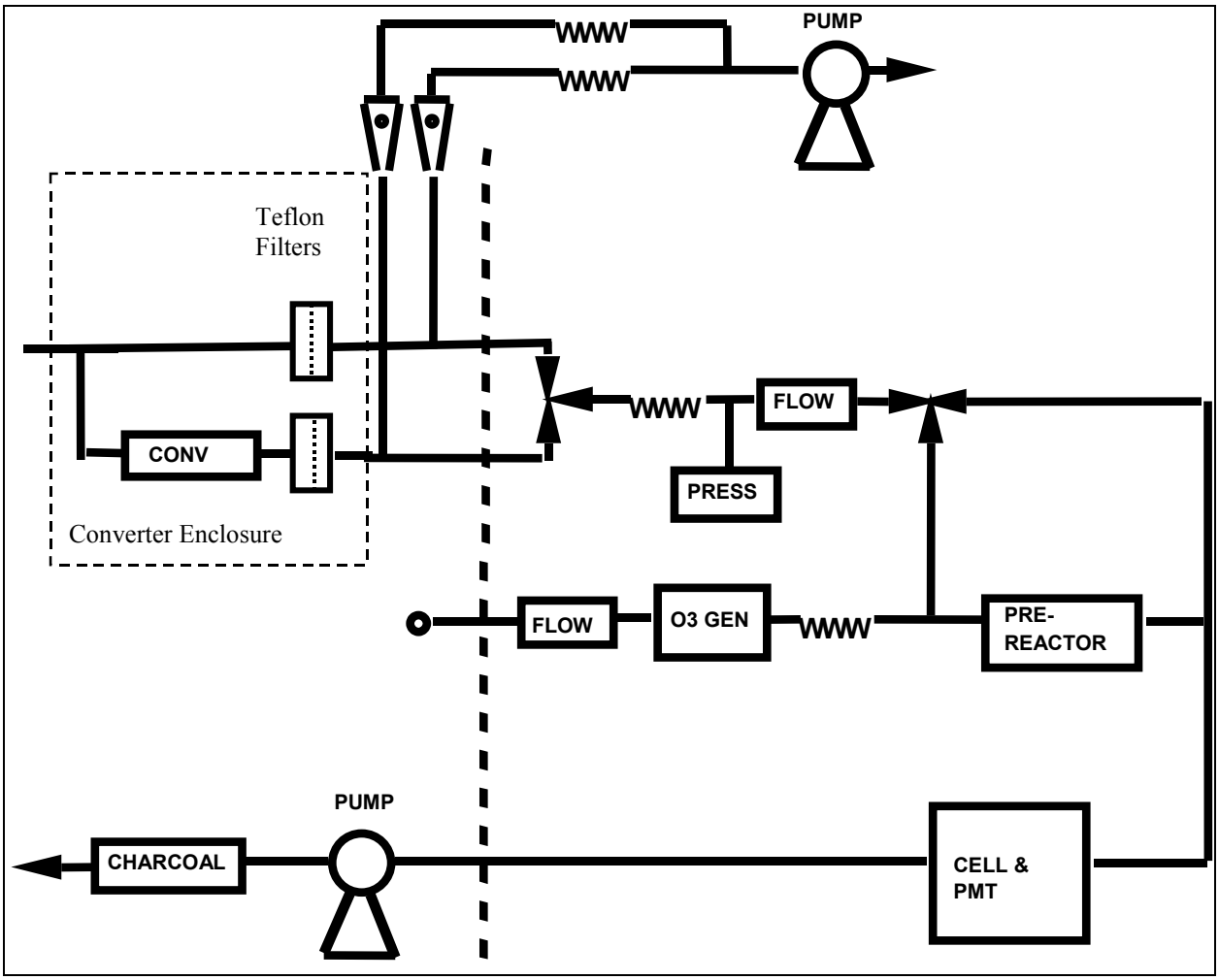

Figure 1. NOy Analyzer Schematic.

4. PERSONNEL HEALTH AND SAFETY

The TECO42-CY instrument contains high voltage electrical hazards and UV light hazards. Do not remove the instrument cover unless you have been properly trained on this instrument. If you only are removing the cover to change filters, then be careful not to touch any of the electrical components and do not look at the UV light source.

Calibrations and routine QC require use of compressed gas cylinders. Cylinders should be properly secured and capped when not in use. Regulators should be installed and removed, following standard safety procedures. Regulators should be leak checked after installation.

Calibrations and routine QC require use of HNO_3 permeation tubes, and possibly NH_3 permeation tubes. During use, the permeation tube emissions are diluted to very low concentration levels and do not pose a significant hazard. However during storage, high concentrations of nitric acid and ammonia can build up in the storage containers. The tube containers should be opened in well vented areas and breathing the fumes be avoided.

5. CAUTIONS

The sample line leading from the ambient sampling point to the catalytic converter should be less than 6 inches. The converter should be mounted outside the site shelter. (The length of lines from the converter to the analyzer may be up to 30 feet).

The HNO_3 calibration gas is generated from a permeation calibrator system. This system must flow continuously at the required concentration through the calibration line and should be introduced as close as possible to the sampling point. If an automatic valve is used, the valve should be made of FEP Teflon, should be located near the sample point, and should be a three-way valve set up to vent a continuous flow of calibration gas when not supplying calibration gas to the sample inlet. The vent must be scrubbed and vented far from the sample inlet.

If NH_3 calibration gas is supplied from a permeation calibrator, the NH_3 gas should be introduced as close as possible to the sampling point through a line that is continually flowing with NH_3 at the required concentration. If an automatic valve is used, the valve should be made of FEP Teflon, and should be a three-way valve set up to vent a continuous flow of calibration gas when not supplying calibration gas to the sample inlet. The vent should be scrubbed and vented far from the sample inlet.

6. INTERFERENCES

Quantitative reduction of nitrate species such as HNO_3 and alkyl nitrates to NO in the converter may be different than reduction of NO_2 to NO. It is necessary to monitor converter efficiency closely. Oxidation of reduced species such as NH_3 may occur to some extent, especially for aged converters or for converters at high temperatures. It is necessary to check converter efficiency for NH_3.

Particulate nitrate species may be converted to NO in the catalytic converter, thus appearing as a component of NO_y. The extent to which nitrate particles are detected by the analyzer is unquantified.

7. PERSONNEL QUALIFICATIONS

Equipment operators should be experienced ambient air quality technicians. The technicians should receive instruction on routine operations by the CE-CERT staff performing the initial installation and setup.

8. EQUIPMENT, SUPPLIES, REAGENTS

Materials needed for TEI Model 42CY NOy setup, routine operation, auditing, and takedown include:

EQUIPMENT: TEI 42CY NO-N02-Nox Analyzer / ENVIRONICS Calibrator / Aadco Pure-Air generator				
ITEM:	**COMPONENT:**	**MANUFACTURER**	**S/N**	**#**
18 gauge ground wire	All			20'
2 strand 8 gauge wire	All			20'
8 each switch box	All			1
8-gauge 3-way, 120 VAC wire	All			35'
instrument rack	All			1
instrument screws	All		10-32 thread x 1 "	20-30 ea.
power strip	All			3
relay box	All	National instruments	ER-16	1
silicone sealant	All			1
Teflon TFE tape	All			3 rolls
Teflon tubing, 1/4"	All			80-100'
1/4" elbow, brass, male thread/compression	Aadco Pure Air system			2
1/4" plug, male thread	Aadco Pure Air system			1
1/4" T-Teflon	Aadco Pure Air system	Swagelock		1
1/4" x 2" pipe, brass	Aadco Pure Air system			3"
1/8" elbow, Teflon, male thread/compression	Aadco Pure Air system	Swagelock	316	1
1/8" Teflon tubing	Aadco Pure Air system			6'
3/8 to 1/4 " reducer, compression/thread	Aadco Pure Air system	Swagelock		1
Aadco 737-R Pure air Generator	Aadco Pure Air system	Aadco	7378-11A	1
Field Logbook	Aadco Pure Air system			1
Instrument Manual	Aadco Pure Air system	Aadco		1
Pressure regulator valve	Aadco Pure Air system	Wilkerson	R08-02 F000	1
pump for Aadco compressor	Aadco Pure Air system	Aadco	737-54	1
vacuum gauge, 0-5 psi	Aadco Pure Air system	Aschcroft		1
1/2" to 1/8" SS thread/compression	Envionics Series 9100 Calibrator	Swagelock		3
1/8" SS tubing	Envionics Series 9100 Calibrator			30'
2" x 4" x 3' board	Envionics Series 9100 Calibrator			2 ea.
chain, metal, heavy gauge	Envionics Series 9100 Calibrator			2 x 4'
cylinder NO	Envionics Series 9100 Calibrator	Scott-Marrin		1
cylinder NH3	Envionics Series 9100 Calibrator	Scott-Marrin		1
cylinder NPN	Envionics Series 9100 Calibrator	Scott-Marrin		1
Environics Series 9100 Calibrator	Envionics Series 9100 Calibrator	Environics	Series 9100	1
eye hooks, 3/8" x 3"	Envionics Series 9100 Calibrator			4
Null Modem RS232 adapter	Envionics Series 9100 Calibrator		D25NM2	1

Operator's manual	Envionics Series 9100 Calibrator	Environics	Model 42 C	1
regulator	Envionics Series 9100 Calibrator	Scott-Marrin	2SS75-660	3
RS232/1 cable, 25 pin	Envionics Series 9100 Calibrator			20'
spring links (for chain ends)	Envionics Series 9100 Calibrator			4 ea.
valve	Envionics Series 9100 Calibrator	?	3161	3
1/4" SS compression	Environics Calibrator Output	Swagelock		2
1/4" to 3/8" compression/male thread	Environics Calibrator Output	Swagelock		2
2-way valve	Environics Calibrator Output	Teqcom	M442C1ATS-HT	1
3 way valve, NC-C-NO	Environics Calibrator Output	Teqcom	M443W1ATS-HT	1
HEPA filter	Environics Calibrator Output	Pall	12144	1
scrubber assembly w/ Drierite	Environics Calibrator Output	Drierite	27068	1
1/4" SS compression	Matrix-air assembly	Swagelock		2
1/4" SS x 1/4" compression/male thread	Matrix-air assembly	Swagelock		2
1/4" to 3/8" compression/male thread	Matrix-air assembly	Swagelock		2
HEPA filter	Matrix-air assembly	Pall	12144	1
pump	Matrix-air assembly	Thomas	107CA818	1
scrubber	Matrix-air assembly	Drierite	27068	1
field Logbook	TEI NO/NOy Analyzer			1
Operator's manual	TEI NO/NOy Analyzer	TEI	Model 42 C	1
TEI 42C No-N02-Nox Analyzer	TEI NO/NOy Analyzer	TEI	Model 42 C	1
1 1/4" galvanized pipe, painted gray	TEI NO/NOy Analyzer Converter Box			10'
1/2" to 1/4" reducer, Teflon	TEI NO/NOy Analyzer Converter Box	Swagelock		1
1/2" x 8" Teflon tubing	TEI NO/NOy Analyzer Converter Box			1 '
1/4" bulkhead fittings	TEI NO/NOy Analyzer Converter Box	Swagelock		3
1/4" SS cross, compression	TEI NO/NOy Analyzer Converter Box	Swagelock		1
1/4" Teflon compression	TEI NO/NOy Analyzer Converter Box	Swagelock		1
1/4" T-Teflon	TEI NO/NOy Analyzer Converter Box	Swagelock		2
1-1/4" U-Clamps	TEI NO/NOy Analyzer Converter Box			2
3 way valve, NC-C-NO	TEI NO/NOy Analyzer Converter Box	Teqcom	M443W1ATS-HT	1
4 way electrical wiring block	TEI NO/NOy Analyzer Converter Box			2
4" ABS cap	TEI NO/NOy Analyzer Converter Box			1
4" ABS tubing	TEI NO/NOy Analyzer Converter Box			10'
4" hole saw	TEI NO/NOy Analyzer Converter Box			
4" roof flange	TEI NO/NOy Analyzer Converter Box			1
4" roof flange doughnut	TEI NO/NOy Analyzer Converter Box			1
bulkhead bracket (for three bulkheads)	TEI NO/NOy Analyzer Converter Box	Swagelock		1
denuder filter canister	TEI NO/NOy Analyzer Converter Box			1
extension cord, heavy-duty to supply power	TEI NO/NOy Analyzer Converter Box			25'
filter canisters, male thread	TEI NO/NOy Analyzer Converter Box	Savillex		2
filters, 0.5ug Teflon	TEI NO/NOy Analyzer Converter Box			1 box
flat gray spray-paint for all surfaces	TEI NO/NOy Analyzer Converter Box			1 can
gray flex tubing, 1-1/2"	TEI NO/NOy Analyzer Converter Box			20'
pallet	TEI NO/NOy Analyzer Converter Box			1
plumbers tape	TEI NO/NOy Analyzer Converter Box			1 roll

plywood	TEI NO/NOy Analyzer Converter Box			1 sheet
purafil scrubber assembly	TEI NO/NOy Analyzer Converter Box	TEI	TEI 4293, part # 6999	1
screws, # 12 x 2" (or 1-1/2 ")	TEI NO/NOy Analyzer Converter Box			1 box
TEI converter box	TEI NO/NOy Analyzer Converter Box	TEI	?	1
tripod for 4" ABS, modified	TEI NO/NOy Analyzer Converter Box			1
1/4" SS compression	TEI NO/NOy Analyzer Dry-Air	Swagelock		2
1/4" to 3/8" Teflon compression/male thread	TEI NO/NOy Analyzer Dry-Air	Swagelock		2
3/8" elbow, Teflon	TEI NO/NOy Analyzer Dry-Air			2
3/8" Teflon tube	TEI NO/NOy Analyzer Dry-Air			8 "
drying medium	TEI NO/NOy Analyzer Dry-Air			1 cup
1/4" SS compression/female thread	TEI NO/NOy Analyzer Exhaust	Swagelock		2
1/4" Teflon compression fitting	TEI NO/NOy Analyzer Exhaust	Swagelock		2
Pump	TEI NO/NOy Analyzer Exhaust	KNF Nueberger	254-N026.38.90	1
scrubber	TEI NO/NOy Analyzer Exhaust	TEI	4291	1
Tools needed:				
Rover toolbox, and:				
assorted cable ties				
assorted screws, Philips, wood 1/2 to 1-1/2 "				
assorted sockets				
assorted various nuts, bolts, washers				
Drill, assorted bits				
hacksaw				
Hole saw, 4 "				
large crescent -for cylinders				
level				
pipe cutter				
plumbers tape				
Power cords				
Sawsall w/ blades				
silicone and gun				
snoop, 1 bottle				
Swagelock groove tool				
Teflon tape, 1 roll				
voltmeter				

In-station Calibration Equipment

- On-site dilution calibrator, automatically controlled, capable of a flow rate of 5 lpm and a dilution ratio adjustable from 50:1 to 500:1 with an accuracy of 1% and a precision of 2%, certified within the last three months prior to use.

- On-site permeation calibrator capable of a 5 lpm flow rate in each of one or two channels, accurate and precise to 5%, capable of temperature control to within 0.5 degree C, certified within the last three months prior to use. Two channels are needed if NH_3 will be generated from a permeation calibrator.

- Purified dry zero air generation system producing air scrubbed of all contaminants and water, with a sustained flow rate of 10 or 15 lpm (5 lpm for HNO_3 permeation, 5 lpm on demand for the dilution calibrator, and 5 lpm for NH_3 if NH_3 permeation is used).

- A matrix air zero generation system producing air scrubbed with Purafil to remove NOy but otherwise altered as little as possible.

- NO in nitrogen, with stainless steel regulator, certified standard, near 28 ppm, NIST traceable.

- N-propylnitrate in nitrogen, with stainless steel regulator, certified standard, 5 to 30 ppm.

- HNO_3 permeation tube, rate near 250 ng/min.

- NH_3 permeation tube, rate near 313 ng/min, or
  NH_3 in nitrogen, with stainless steel regulator, certified standard, 5 to 30 ppm.

For the CRAQPS annual study, these requirements will be satisfied by an Environics Model 9100 calibrator having a dilution flow rate of 2 to 20 slpm, a calibration gas flow of 10 to 100 sccm, and a single channel permeation calibrator having a flow rate of 5 lpm. NH3 will be supplied from gas cylinders.

Quarterly QC Equipment

- Flow meter for measurement of in-station calibrator flow rates. These will consist of one or two values in the range of 2 to 20 slpm, and one or two values in the range of 10 to 100 sccm.
- Flow meter for measurement of sample and bypass flow rates. The values will range from 0.5 to 1.5 LPM.
- Dilution calibrator, independent of station operators equipment, capable of a flow rate of 5 lpm and a dilution ratio adjustable from 50:1 to 500:1 with an accuracy of 1% and a precision of 2%, certified within the last three months prior to use.
- Ultrapure zero air supplied from a cylinder with regulator to supply dilution calibrator.
- A matrix air zero generation system producing air scrubbed with Purafil to remove NOy but otherwise altered as little as possible.
- NO in nitrogen, with stainless steel regulator, certified standard, near 28 ppm, NIST traceable
- N-propylnitrate in nitrogen, with stainless steel regulator, certified standard, 5 to 30 ppm
- NH_3 in nitrogen, with stainless steel regulator, certified standard, 5 to 30 ppm

In-Station Maintenance Supplies for Biweekly Check

- In-line filters: Teflon membrane, 5 um pore size
- NaCl coated fabric denuder in filter holder

Quarterly Maintenance Supplies

- HNO_3 calibration vent scrubber
- Purafil replacement cartridge
- Matrix air compressor guard filters
- Aadco compressor guard filters
- In-line filters: Teflon membrane, 5 um pore size
- ¼ inch OD PFA Teflon tubing
- Assorted ¼ Swagelock stainless steel fittings
- ¼ inch PFA Teflon tees

Tools

- 3/8" to 3/4" open end wrenches
- 12" crescent wrench

- #1 and #2 Phillips screwdrivers
- 1/8" to 3/8" flat-blade screwdrivers

9. SITE AND EQUIPMENT PREPARATION

Offsite Acceptance Testing

Analyzers are tested and accepted following procedures described in CE-CERT SOP CRPAQS-002, "Acceptance Testing of TECO42-CY Analyzers for NOy Monitoring for CRPAQS". These procedures ensure that the analyzer is performing within manufacturer specifications for NO and NO_2, and they ensure that the analyzers are performing to with CRPAQS specifications for HNO_3, HONO, PAN, NPN, and NH_3.

On-site Acceptance Testing

After installation the analyzers receive a multi-point calibration and are subjected to the Quarterly QC checks. The analyzers are accepted if they pass the Quarterly QC checks.

Installation requirements

The NOy instrument must be installed in a temperature controlled shelter with temperature regulated between 20 to 30 C.

The sample line from the catalytic converter to the ambient sampling point must be less than 6 inches. The sampling point should be located 3 to 5 meters above ground level, at least 1 meter from all obstructions, and at least 10 meters from obstructions over a range of at least 180 degrees. These requirements necessitate mounting the catalytic converter outside the shelter. The sample bypass lines from the converter to the instrument should not exceed 10 meters in length.

The calibration system should be plumbed as shown in **Figure 2**. The inlet to the small compressor must be drawn from outside the station away from calibration gas vents. This air passed through Purafil only in order to remove NOy but to leave the ambient air changed as little as possible otherwise. If the compressor flow must be throttled, the needle valve should be placed on the inlet side of the pump to prevent compression and possible water condensation on the output side. This system shown in Figure 2 provides the following options for calibrations and QC checks:

- Purafil-scrubbed ambient air (matrix zero air)
- Aadco scrubbed air (dry pure zero air)
- A continuously vented flow of HNO3 gas from the permeation calibrator
- Cylinder gas diluted with dry pure zero air
- Cylinder gas diluted with Purafil-scrubbed ambient air (matrix zero air)
- Cylinder gas diluted with ambient air (standard additions to matrix air)

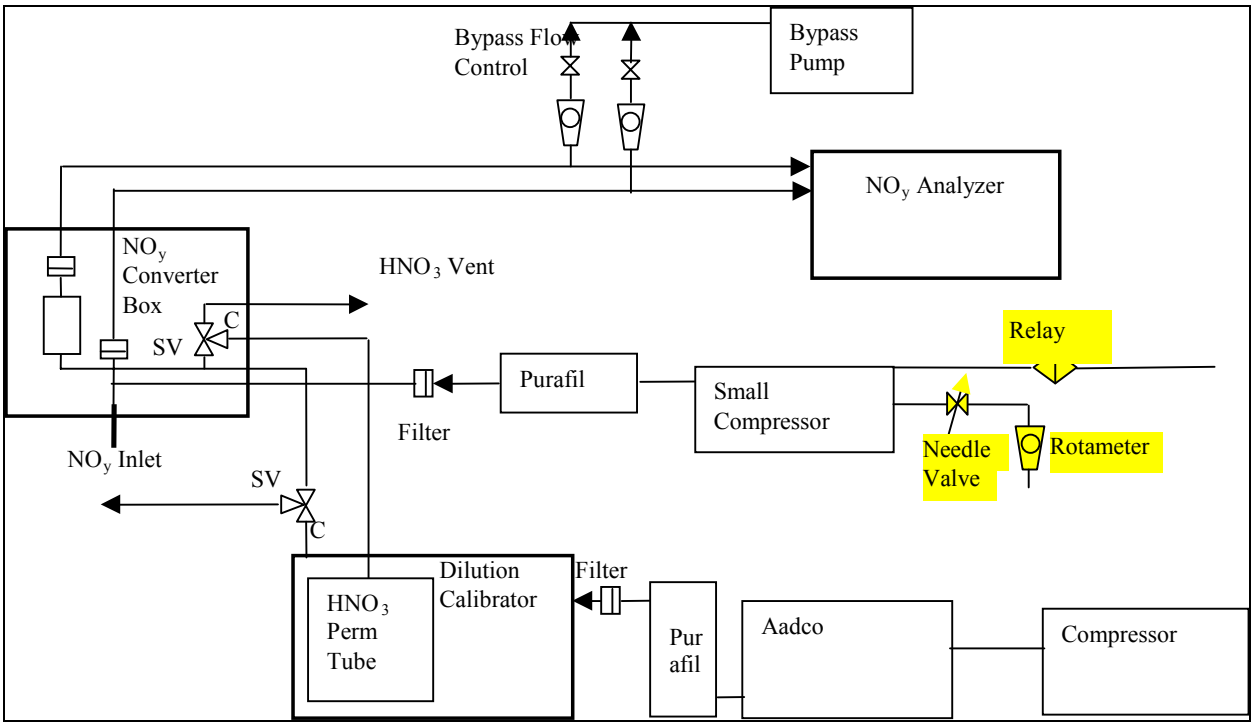

Figure 2. Calibration system.

Data Acquisition Requirements

Two DAS channels are needed for monitoring data: NOy and NO. The DAS should be capable of recording 1 minute averages for review of calibration and QC data. Routine monitoring data should be recorded as 5 minute averages or better for review of time patterns in the data. After review, data may be averaged to hourly intervals. If available, an additional DAS channels should be used to monitor diagnostic outputs: catalytic converter temperature, reaction cell pressure, sample flow rate. Additional DAS channels are required to monitor the operational status of the calibration/sampling system. At a minimum, the DAS should include a channel to indicate sample/other. Ideally, additional channels such as dry zero/ambient zero, dilution calibrator/permeation calibrator, ozone on/off, etc. would describe the nature of "other".

10. CALIBRATION AND QC CHECKS

10.1 Overview

The analyzer needs to receive a multi-point calibration whenever the events listed below occur. The calibration is performed following STI SOP. Refer to standard procedures for calibration of NO/NOx analyzers using gas phase titration (GPT) of NO gas standards.

Instructions for performing the QC and the maintenance procedures are given in Section 10.3. Tolerances for the QC procedures are shown in **Table 1.**

- Quarterly
- Whenever the instrument is turned off for more that 7 days
- When the instrument is physically moved during a power down
- When major repairs are made to the instrument
- When other changes are made that may affect the calibration such as a change of filter type, change of sample inlet line, or change of range for which there is no calibration curve.

Quality control includes regular maintenance and performance checks performed at daily, weekly, monthly and annual intervals.

10.2 Frequencies/Overview

5-hourly checks

- Automatic zero with Purafil scrubbed ambient air

Daily Checks

- Automatic zero with dry pure zero air
- Automatic span (90 ppb) with NPN in dry pure zero air
- Automatic span with NO (90 ppb) in dry pure zero air
- Automatic span with NO_2 (~60 ppb) by GPT in dry pure zero air
- Automatic zero with dry pure zero air
- Ambient recovery
- Converter temperature
- Reaction cell pressure

Weekly or Bi-Weekly Checks

- Check analyzer settings
- Zero with matrix zero air
- Zero with dry pure zero air
- Low NO span (90 ppb) in dry pure zero air
- Replace Teflon filter
- Low NO span (90 ppb) in dry pure zero air
- High NO span (450 ppb) in dry pure zero air
- High NO GPT (~350 ppb NO_2 and ~100 ppb NO) converter check in dry pure zero air
- Zero with dry pure zero air
- NH_3 (~90 ppb) response check in dry pure zero air
- Install NaCl denuder on HNO_3 cal line
- HNO_3 (~20 ppb) premeation composition check in dry pure zero air
- Remove NaCl denuder from HNO_3 cal line
- HNO_3 (~20 ppb) response in dry pure zero air

- Zero with dry pure zero air
- Zero with matrix zero air
- Ambient purge
- Check ambient zero scrubber system and ultrapure zero systems,
- Replace cartridges and filters as needed

Quarterly

- Perform independent multipoint calibration with NO (~450, 350, 250, 150, 75, 0 ppb) and NO_2 by GPT (~350 ppb) in ultrapure air
- Perform independent flow rate checks
- Replace cartridges in scrubber systems

Table 1. QC Tolerances.

QC Check	Tolerance
Internal zero	0 ± 1.5 ppb
External zero	0 ± 1.5 ppb
Low NO span 90 ppb	± 15%
High NO span 450 ppb	± 15%
Converter efficiency for NO_2	≥ 96%
CH_7ONO_2 check	± 15%
Units	ppb
Ranges	1000 ppb
BKGs	0.00 ppb
Coeffs.	NO_x +/- 1% NO
Ozonator	On
PMT supply	On
Auto / Manual / NO/NOy	NO/NOy
Temperature Correction	On
Pressure Correction	On
PMT Voltage	site specific value (800 to 1000V) ± 5V
+15V	± 1.0 V
-15V	± 1.0 V
+5V	± 0.1 V
Internal Temp	20 to 35 °C
Chamber Temp	48 to 52 °C
Cooler Temp	< -10 °C
NO_y Conv Temp Set	320 to 350 °C
NO_y Conv. Temp	± 10 °C from set
Chamber Pressure	200 to 450 torr
Ozonator Flow Rate	0.10 ± 0.01 LPM
Sample Flow Rate	1.25 ± 0.05 LPM
NO_y Bypass Flow Rate	1.00 ± 0.3 LPM
NO Bypass Flow Rate	1.00 ± 0.3 LPM

10.3 Procedures

This section defines the setup and goals of the routine operations to be performed on the NOy instrument. A "Quick Reference Guide" is presented at the end of this SOP and identifies the routine operation and maintenance tasks that need to be done on the TEI 42CY instrument for CRPAQS. This guide summarizes by task the performance statistic (see Table 1), the location in the SOP or manual for guidance on how to perform the task, the location in the SOP or manual for guidance if the performance statistic is not met, the frequency of the task, an estimate of the duration of the task, and whether or not a worksheet has been compiled for the task. Explicit procedures for each task follow the guide.

10.3.1 Daily Checks

1. Plumb the automated calibration system as shown in **Figure 2**. Supply at least 5 LPM of calibration gas or zero air to the sample inlet.

2. Program the calibrator to provide the following sequence once per day between midnight and 4 AM. Avoid performing the daily calibration after 4 AM.

3. The Matrix Zero Air Check: Program the calibrator to provide Purafil scrubbed ambient zero air for 10 minutes followed by 10 minutes of ambient purge (i.e. discard the first 10 minutes of ambient data) approximately every 2 to 6 hours. This check is useful to determine zero response, particularly of the NOy channel, in the presence of interferences such as NH3 and in the presence of NOy time lags introduced by the catalytic converter. The Matrix Air system should provide the following to the NOy instrument:

   - 10 minutes of pure dry zero air (from the Matrix Zero Air System)

   At the CRPAQS sites, the Matrix Air checks are programmed to occur at the following times:

   - 05:45
   - 10:45
   - 15:45
   - 20:45

   Record the Matrix Air NO and NOy responses onto worksheet containing task 1.

4. The Zero-Span Check: Program the calibrator to provide the following gas concentrations to the NOy instrument:

   - 10 minutes of pure dry zero air (from the Aadco Zero Air Generator)
   - 10 minutes of NPN diluted with pure dry zero air to 90 ppb

- 10 minutes of NO diluted with pure dry zero air to 90 ppb
- 10 minutes of NO2 by GPT at about 60 ppb NO2 and 30 ppb NO
- 10 minutes of dry pure zero air (from the Aadco Zero Air Generator)
- 10 minutes ambient recovery (i.e. discard the first 10 minutes of ambient data)

At the CRPAQS sites, the Zero-Span Check is programmed to occur at:

- 00:44

Record the Zero-Span values for the NO and NOy responses onto worksheet containing task 2.

5. Optional Method of Addition Calibrations: Program calibrator to add NO, or NPN, or HNO3 to the sample inlet for 10 minutes followed by 10 minutes of ambient purge approximately every 6 hours. Net response is calculated by subtracting the average response observed before and after the gas addition from the response observed during the gas addition. The dilution ratio is determined by the sample flow rate, which must therefore be accurately controlled. This check is useful to determine the effect of interferences such as humidity and NH3 on analyzer response in the presence of NO and NOy. This check is best suited for locations where NO and NOy concentrations are changing very slowly. This check involves low flow rates of undiluted calibration gas. Residence times in the lines must be considered, and lines should be purged for at least three residence times before collecting data. An example sequence is provided below:

   - 5 minutes undiluted NO gas at 100 sccm to purge air from lines
   - 10 minutes undiluted NO gas at 10 sccm, record final value
   - 5 minutes pure dry zero air at .500 sccm to purge gas from lines
   - 5 minutes of ambient recovery (ambient data discarded)

6. Optional Matrix Zero Calibrations: for areas of times where ambient concentrations are not varying slowly, the methods of standard additions may be modified to use matrix zero air rather than matrix air. an example sequence is given below:

   - 10 minutes matrix zero air (leave matrix zero system turned on)
   - 5 minutes undiluted cal gas at 100 sccm to purge air from lines
   - 10 minutes undiluted cal gas at 10 sccm, record final value
   - 5 minutes pure dry zero air at .500 sccm to purge gas from lines
   - 5 minutes of matrix zero air
   - Turn off matrix zero air system
   - 5 minutes of ambient recovery (ambient data discarded)

7. Poll data logger and review QC data as well as diurnal patterns daily (weekdays)

10.3.2 Biweekly Check

Biweekly check results are recorded on worksheet containing task 4. Archive and deliver the completed worksheet to the Field Manager on a biweekly basis.

1. Site Identification: Fill out the identification data indicated on the Weekly Checklist form.

2. Analyzer Settings: Using the instrument front panel, check and record the following settings and diagnostic voltages as indicated on the Biweekly Checklist form.

3. Maintenance checks: Check the status of the zero air systems, the calibrator flowrates, and the cylinder pressures and record the results on the Biweekly Checklist form.

4. Calibration Check: During the following checks, record both channels of instrument response: "NO" and "NO_y ". For each gas selection record the start time, end time, and ending value. Compare instrument responses with the tolerances shown in Section 9 and report out-of-tolerance readings immediately to the Field Manager.

   Before changing the filters:
   - 10 minutes of dry pure zero air
   - 10 minutes of 90 ppb NO in dry pure zero air

   Change the Teflon filters and continue the sequence of calibration gases:
   - 10 minutes of 90 ppb NO in dry pure zero air
   - 10 minutes of 450 ppb NO in dry pure zero air

   Turn on O3 generator lamp
   - 10 minutes of GPT at approximately 350 ppb NO2, 100 ppb NO
   - 10 minutes of dry pure zero air
   - 10 minutes of NH3 at 90 ppb in dry pure zero air
   - 5 minutes of dry pure zero air to purge lines

   Install NaCl denuder in HNO3 calibration line near converter box.
   - Attain a stable reading for at least 10 minutes of 20 ppb HNO3 from permeation calibrator diluted in dry pure zero air

   Remove NaCl denuder from HNO3 calibration line
   - Attain a stable reading for at least 10 minutes of 20 ppb HNO3 from permeation calibrator diluted in dry pure zero air
   - 10 minutes of dry pure zero air
   - 10 minutes of matrix zero air

   Allow system to recover to ambient concentrations:
   - 10 minutes of ambient recovery

10.3.3 Quarterly Checks

Maintenance performed by station operators

- Replace Purafil cartridges
- Replace guard filters

QC checks by external group

- Check in-station dilution calibrator flow rates
- Check in-station permeation calibrator flow rates
- Check sample and bypass flow rates
- Check in-station dry pure zero air against ultrapure cylinder air (before cartridge change)
- Perform/observe weekly check using in-station equipment
- Perform multipoint NO cal and GPT per STI NOx SOP using independent gases and calibrator
- Perform NPN cal check using independent gases and calibrator
- Check in-station dry pure zero air against ultrapure cylinder air (after cartridge change)
- Compare performance with tolerances.

11. INSTRUMENT OPERATION

Startup

- Install the analyzer as described in Section 9.

- Allow the analyzer to run for at least 4 hours before performing initial on-site calibration (quarterly check).

Operation

- The instrument does not require routine operating procedures other than those specified in other sections of this procedure. These consist primarily of proper installation, calibration and QC checks, data review and validation, and instrument shutdown.

Final Shutdown

- Perform a final calibration (quarterly check) before turning off the analyzer.

- Record the time that the analyzer was turned off in the comments section of the Quarterly QC worksheet, the instrument log, and site log.

- Label the analyzer and the catalytic converter with project and site identification information to distinguish them from any spares that may be on site.

12. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

No samples are stored in this procedures. Sample is drawn directly from the ambient air into the catalytic converter, at a height of 3 to 5 meters above ground, at least 1 meter away from all obstructions, and free from all obstruction over 180 degrees or more.

13. SAMPLE PREPARATION

There is no sample preparation for this method.

14. PREVENTIVE MAINTENENACE AND REPAIRS

Preventive maintenance

Follow routine QC checks described in Section 10. These include:

Weekly:
- Change Teflon filters
- Record the time that the analyzer was offline in the instrument log and site log.

Quarterly:
- Replace Purafil scrubber cartridges
- Replace guard filters
- Record the time that the analyzer was offline in the instrument log and site log.

Operational Performance checks

- Follow routine QC checks described in Section 10

15. TROUBLESHOOTING

Low converter efficiency (<95%)

- Raise temperature set point in 5°C increments until efficiency is over 95%
- Replace converter if more than 399°C is reached

Converter replacement:

- Have converter checked out by CE-CERT acceptance procedures prior to field installation
- After field installation check converter efficiency using weekly procedure

16. DATA ACQUISITION, CALCULATIONS, AND DATA REDUCTION

Slopes and intercepts determined from the multipoint calibrations will be used to calculate calibrated ppb values from instrument responses recorded by the DAS. Scrubbed ambient zero checks may be used to adjust the data offset several times per day. Matrix air calibrations or scrubbed matrix air calibrations may be used to alter slopes and intercepts of calibrations.

17. COMPUTER HARDWARE AND SOFTWARE

See Data Acquisition System (DAS) SOP.

18. DATA MANAGEMENT AND RECORDS MANAGEMENT

See QIWP.

19. METHOD PERFORMANCE

The measurement quality objectives for this analyzer are shown in the attached **Table 2**. CE-CERT does not yet have sufficient experience operating these instruments to assess the typical accuracy and precision achieved by following the procedures described in this SOP.

20. REFERENCES

Nees, Monica (USEPA) (1993). Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. I: A Field Guide to Environmental Quality Assurance. EPA-600/R-94/038a, EPA, ORD, Research Triangle Park, 1993.

USEPA (1994). Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II: Ambient Air Specific Methods (Interim Edition). EPA-600/R-94/038b, ORD, Research Triangle Park, NC.

Table 2. Measurement Quality Objectives.

Measurement Quality Objectives - NO_2 and NO_y (Chemiluminescence)

Requirement	Frequency	Acceptance Criteria	Reference	Information/Action
Standard Reporting Units	All data	ppb		
Sample Period	All data	5 minutes	Field Plan, Table 4.4-6	
Measurement Range	All data	0 – 450 ppb		
Shelter Temperature Temperature range Temperature control	 Daily Daily	 20 to 30 ˚C ± 2 ˚C	 40 CFR, Pt. 53.20 Vol II, S 7.1 [1/] Vol II, MS 2.3.2	Instruments designated as reference or equivalent have been tested over this temperature range. Maintain shelter temperature above sample dewpoint. Shelter should have a 24- hour temperature recorder. Flag all data for which temperature range or fluctuations are outside acceptance criteria.
Equipment NO_2 analyzer Air flow controllers Flowmeters	 Purchase specification	 Reference or equivalent method Flow rate regulated to ± 2 % Accuracy ± 2 %	 40 CFR, Pt 53.9 40 CFR, Pt 50, App F, S 2.2 EPA-600/4-75-003	Objectives generally based on EPA requirements for NO_2 criteria pollutant monitoring.
Detection Noise Lower detectable level	 Purchase specification	 0.025 ppb or 0.1% of reading 0.5 ppb or 0.2% of reading	 Instrument specifications	
Completeness Hourly Data	 Monthly	 80 %		
Compressed Gases Dilution gas (zero air) Gaseous standards	 Purchase specification Purchase specification	 Free of contaminants NIST Traceable (e.g., EPA Protocol Gas)	 EPA-600/4-75-003 40 CFR, Pt 50, App F, S 1.3 EPA-600/R-97/121	 Return cylinder to supplier. Nitric oxide in nitrogen EPA Protocol Gases have a 24-month certification period and must be recertified to extend the certification.

Measurement Quality Objectives - NO_2 and NO_y (Chemiluminescence)

Requirement	Frequency	Acceptance Criteria	Reference	Information/Action
Precision				
Single analyzer	1/ 2 weeks	None	40 CFR, Pt 58, App A	Concentration. = 8 - 10 ppb.
Reporting organization	1/3 months	95 % Confidence Interval ± 15 %	EPA-600/4-83-023 Vol II, App 15, S 6	
Accuracy				
Single analyzer	1/year	None	40 CFR, Pt 58, App A	Four concentration ranges. If failure,
Reporting organization	1/year	95% Confidence Interval ± 20%	EPA-600/4-83-023 Vol II, App 15, S 3	recalibrate analyzer and reanalyze samples. Repeated failure requires corrective action.

[1] - Reference refers to the QA Handbook for Air Pollution Measurement Systems, Volume II . The use of "S" refers to sections within Part 1 of Volume II. The use of "MS" refers to method-specific sections in Volume II.

Task Table 1: TEI 42CY NOy Analyzer Quick Reference Sheet

(Detailed procedures and troubleshooting for each task follow the Task Table 1 and are listed by task number.)

Task		Performance statistic	Task guidance	Troubleshooting guidance	Frequency	Time	Worksheet
1	**Check automatic matrix-air zero.**	< +/- 1.5 ppb	Task 1	N/A	5-hourly	30 min	Yes
2	**Check automatic zero and span:**	See below	Task 2	N/A	Daily	65 min	Yes
	Zero with matrix zero-air	0 +/- 1.5 ppb		N/A			
	Zero with Aadco pure zero-air	0 +/- 1.5 ppb		N/A			
	Span (90 ppb) with NPN in zero-air	+/- 15%		N/A			
	Span with NO (90 ppb) in zero-air	+/- 15%		M p 6-2, M Chap 4			
	Span with NO_2 (~60 ppb) by GPT in zero-air	N/A		N/A			
	Zero with Aadco pure zero-air	0 +/- 1.5 ppb		N/A			
	Zero with matrix zero-air	0 +/- 1.5 ppb		N/A			
	Converter temperature set 300 - 399 C	+/- 1 C of ref		M p 3-68			
	Reaction cell pressure	200-450 torr		M p 7-4			
3	**Weekly maintenance:** Change out filters in external converter box	N/A	Task 3	N/A	Weekly	15 min	Yes

Task		Performance statistic	Task guidance	Troubleshooting guidance	Frequency	Time	Worksheet
4	**Instrument checks:**	See below	Task 4	See below	Biweekly	10 min	Yes
4a)	**Site Identification**	N/A		N/A			
4b)	**Analyzer settings:**	See below		See below			
	Channel range and units settings	1000 ppb		M p 3-12			
	Background and Gain Settings	0.00 ppb, NO_x $\pm$1% of NO		M p 3-18, M p 6.2			
	Instrument control settings:	See below		See below			
	Ozonator	On		M p 3-25			
	PMT supply	On		M p 3-26			
	Auto / Manual / NO/NOy	NO/NOy		M 3-27			
	Temp correction	On		M 3-28			
	Pressure correction	On		M 3-29			
	Diagnostic voltages:	See below		See below			
	+5	+/- 0.1 V		M p 7-13			
	+15 & -15	+/- 1.0 V		M p 7-13			
	Cell pressure in each of three modes	200-450 torr		Capillaries, M p 5-2; Pump, M 7-4			
	NOy converter temperature set point	320 to 350 C		M p 3-68			
	NOy converter temperature	+/- 10 C from set		M p 7-9			
	Analyzer sample flow rate in three modes:	See below		See below			
	Ozonator flow rate	.10 +/- .01 LPM		Capillaries, M p5-2			
	Sample flow rate	1.25 +/- .05 LPM		Filters/Capillaries, M p 5-2			
4c)	**Check the status of the zero air systems:**	N/A		N/A			
	Check the status of the in-station calibrator flow rates	N/A		N/A			
	Check the calibration gas cylinder pressures	N/A		N/A			

Task		Performance statistic	Task guidance	Troubleshooting guidance	Frequency	Time	Worksheet
4d)	**Biweekly system audit:**	See below	Task 4	See below	Biweekly	3 h total	Yes
	Run NO_y weekly1.cal	See below		See below			
	Zero with matrix zero air	0 +/- 1.5 ppb		N/A			
	Zero with dry pure zero air	0 +/- 1.5 ppb		N/A			
	Low NO span (90 ppb) in dry pure zero air	+/- 15%		N/A			
	Change teflon filters	N/A		N/A			
	Run NO_y weekly2.cal	See below		See below			
	Low NO span (90 ppb) in dry pure zero air	+/- 15%		M p 6-2, M Chap 4			
	High NO span (450 ppb) in dry pure zero air	+/- 15%		M p 6-2, M Chap 4			
	High NO GPT (~350ppb NO_2, 100ppb NO) converter check in dry pure zero air	N/A		N/A			
	Zero with dry pure zero air	0 +/- 1.5 ppb		N/A			
	Calculate converter efficiency	>96%		N/A			
	NH_3 (~90 ppb) response check in dry zero air.	+/-10%		N/A			
	Zero with dry pure zero air	N/A		N/A			
	Install NaCl denuder in HNO_3 calibration line in converter box	For non-HNO_3 conc of source		N/A			
	Run NO_y weekly3a.cal	See below		See below			
	HNO_3 (~20 ppb) w/ NaCl denuder.	< 0.1 ppb / 5 min		N/A			
	Remove NaCl denuder in HNO_3 calibration line in converter box	For total NO_y conc of source		N/A			
	Run NO_y weekly3b.cal	See below		See below			
	HNO_3 (~20 ppb) w/o NaCl denuder.	< 0.1 ppb / 5 min		N/A			
	Calculate Measured HNO_3	± 15% of ref		N/A			
	Run NO_y weekly4.cal	See below		See below			
	Zero with dry pure zero air	0 +/- 1.5 ppb		N/A			
	Zero with matrix zero air	0 +/- 1.5 ppb		N/A			
	Allow instrument to stabilize on ambient air	N/A		N/A			
5	**System maintenance**	N/A	Task 5	N/A	Quarterly	30 min	No
6	**Independent multipoint calibration**	Slope ± 15%,	Task 6	M p 6-3	Quarterly	3 h	No

Task		Performance statistic	Task guidance	Troubleshooting guidance	Frequency	Time	Worksheet
		R > 0.95					
7	**Independent flow rate checks**	+/- 2%	Task 7	N/A	Quarterly	1h	No

Maintenance Supplies

- In-line filters: Teflon membrane, 5 um pore size
- NaCl coated fabric denuder in filter holder
- HNO3 calibration vent scrubber
- Purafil replacement cartridge
- Matrix air and Aadco compressor guard filters

Task 1: Check automatic matrix zero-air

Investigate the response of the NOy instrument to Matrix Air. The instrument should demonstrate zero response to NO and NOy at the times listed below. This check is useful to determine zero response, particularly of the NOy channel, in the presence of interferences such as NH3 and in the presence of NOy time lags introduced by the catalytic converter. Look at the Channel 0 graph and see that the prior day has shown the desired response for at least a single 5-min increment. Record the findings on the worksheet.

- 05:45
- 10:45
- 15:45
- 20:45

Task 2: Check automatic zero-span

Investigate the response of the NOy instrument to different gases and concentrations. The instrument should demonstrate the responses described below to NO and NOy beginning at the indicated time. The responses are summarized in **Task Table 2** and are based on the concentrations and types of gases the instrument is challenged with.

- 00:44

Task Table 2. Response of TEI 42CY NOy instrument to calibration gases.

Calibrator	NO response	NO_2 response	NO_y response
10 minutes of pure dry zero air (0-Air Generator)	0	0	0
10 minutes of 90 ppb of NPN	0	90 ppb	90 ppb
10 minutes of 90 ppb of NO	90 ppb	0	90 ppb
10 minutes of 60 ppb O3 and 30 ppb NO	30 ppb	60 ppb	90 ppb
10 minutes of dry pure zero air (0-Air Generator)	0	0	0

Check that the sequence was executed on the Channel 0 graph within 10-mins of the start time. Save and print the Channel 0 graph by following the listed steps. Note the concentrations that were achieved on the graph and paste it into the NOy instrument log. Record the findings on the worksheet.

- "Zoom" on the Channel 0 graph.
- Adjust the graph to show the desired time of interest.
- Hold down the "Alt" key while pressing the "Print Scn" key.
- Go to the "Start" button and scroll to Program Files/Accessories/Paint.
- "Paste" the graph from the top menu bar: Edit/Paste.
- "Save" the graph to the working computer by going to the Network Neighborhood and then going to the work directory on the working computer: C: or D:/Work/NOy graphs/SSS MMDDYY NOy.bmp, where SSS is the site acronym and MMDDYY is the current date.
- Change the Page Setup to Landscape and print the file.

Instrument:	Thermo Environmental Instruments 42CY NOy Analyzer
Worksheet:	Task 1 - Check automatic matrix-air zero (daily)
	Task 2 - Check automatic zero and span (daily)
Site Code:	

Date		/ /	/ /	/ /	/ /	/ /
Field Tech						
Instrument SN						
INITIAL CHECKS:						
Time						
DAS clock (PST)		: :	: :	: :	: :	: :
NOy clock (PST)		: :	: :	: :	: :	: :
1.) CHECK AUTOMATIC MATRIX ZERO-AIR:						
05:45 Zero-air value (ppb)	0 ppb NO					
	0 ppb NOy					
10:45 Zero-air value (ppb)	0 ppb NO					
	0 ppb NOy					
15:45 Zero-air value (ppb)	0 ppb NO					
	0 ppb NOy					
20:45 Zero-air value (ppb)	0 ppb NO					
	0 ppb NOy					
Comments						
2.) CHECK AUTOMATIC ZERO AND SPAN:						
Zero-air value (ppb)	0 ppb NO					
	0 ppb NOy					
90 ppb NPN value (ppb)	0 ppb NO					
	90 ppb NOy					
90 ppb NO value (ppb)	90 ppb NO					
	90 ppb NOy					
60 ppb NO_2 by GPT value (ppb)	30 ppb NO					
	90 ppb NOy					
Zero air value (ppb)	0 ppb NO					
	0 ppb NOy					
Comments						
RECORDKEEPING:						
Printed graph?		Yes / No	Yes / No	Yes / No	Yes / No	Yes / No

Task 3: Instrument checks and Biweekly system audit

Biweekly check results should be recorded on the worksheet. Archive and deliver the completed worksheet to the STI Field Operations manager biweekly.

Task 3a. Site Identification

- Site
- Date
- Time
- Technician
- Instrument ID

Task 3b. Analyzer Settings

- Channel range and units settings
- Background and gain settings
- Instrument control settings
- Diagnostic voltages
- Cell pressure in each of three modes
- Diagnostic temperatures
- Diagnostic Ozonator flow rate for three modes
- Diagnostic Sample flow rate for three modes

Task 3c. Maintenance checks

- Check the status of the zero air systems
- Check the status of the in-station calibrator flow rates
- Check the calibration gas cylinder pressures

Task 3d. Biweekly system audit

During the following checks, record both channels of instrument response: "NO" and "NO_y ". For each gas selection record the start time, end time, and ending value.

Begin "logging" the calibration check information (Channel 4) on a DAS graph by flipping the toggle next to the graph

Make a note in the text box on the DAS: "NOy biweekly calibration check"

Before changing the filters

- 10 minutes matrix zero
- 10 minutes dry zero air
- 10 minutes 90 ppb NO
- Leave 90 ppb NO running

Change the two Teflon filters in the converter box quickly

Continue the sequence of calibration gases

- 10 minutes of 90 ppb NO in dry pure zero air
- 10 minutes of 450 ppb NO in dry pure zero air

Turn on O_3 generator lamp

- 10 minutes of GPT at approximately 350 ppb NO_2, 100 ppb NO
- Calculate converter efficiency:
  Efficiency = $[[(NO_{high} - NO_{GPT}) - (NO_{x\ high} - NO_{x\ GPT})]/(NO_{high}-NO_{GTP})] * 100$
- 10 minutes of dry pure zero air
- 10 minutes of NH_3 at 90 ppb in dry pure zero air
- 5 minutes of dry pure zero air to purge lines

Install NaCl denuder in HNO_3 calibration line near converter box

- Supply 20 ppb HNO_3 from the permeation calibrator diluted in dry pure zero air
- Allow HNO_3 response to stabilize for at least 10 minutes for zero HNO_3 response (drift $<$ 0.1 ppb / 5 minutes)

Remove NaCl denuder from HNO_3 calibration line:

- Supply 20 ppb HNO_3 from the permeation calibrator diluted in dry pure zero air
- Allow HNO_3 response to stabilize for at least 10 minutes (drift $<$0.1 ppb/ 5 minutes)
- Calculate HNO_3 by subtracting the zero HNO_3 response
- 10 minutes of dry pure zero air
- 10 minutes of matrix zero air

Allow system to recover to ambient concentrations:

- 10 minutes of ambient recovery

Remove the note in the text box on the DAS: "NOy biweekly calibration check"

Save the calibration check data

Save the Channel 4 data that was recorded on one of the graph areas on the DAS to the DAS computer directory Manual Calibrations and Audits AND to the ZIP disk as SSS MMDDYY NOy.txt, where SSS is the site acronym and MMDDYY is the current date. Transfer SSS MMDDYY NOy.txt from the ZIP disk to the working computer and send file to the Field Manager.

Compare the instrument responses with the tolerances. Report out-of-tolerance readings immediately to the CRPAQS Field Manager.

Task 4: System maintenance

Monitor and maintain the Zero Air and Calibration Systems quarterly. Perform the tasks listed below. Record any changes in the instrument log.

- Replace Purafil cartridges
- Replace guard filters

Task 5: Independent multipoint calibration with NO and NO_2

To be performed by an independent audit team.

Task 6: Independent flow rate checks

To be performed by an independent audit team.

Instrument:	Thermo Environmental Instruments 42CY NOy Analyzer				
Worksheet:	Task 3 - Instrument checks and biweekly system audit (biweekly)				page 1
Site Code:					
Date	/ /	/ /	/ /	/ /	/ /
Field Tech					
Instrument SN					
INITIAL CHECKS:					
Time					
DAS clock (PST)	: :	: :	: :	: :	: :
NOy clock (PST)	: :	: :	: :	: :	: :
3.) INSTRUMENT CHECKS:					
Range					
NO range / units	/	/	/	/	/
NOy range / units	/	/	/	/	/
Averaging time (sec)					
Calibration factors					
NO BKG / Coeff	/	/	/	/	/
NOy BKG / Coeff	/	/	/	/	/
Pre BKG					
Instrument controls					
Ozonator?	On / Off	On / Off	On / Off	On / Off	On / Off
PMT supply?	On / Off	On / Off	On / Off	On / Off	On / Off
NO/NOy / Auto / Manual?	NO/NOy / Auto / Manual	NO/NOy / Auto / Manual	NO/NOy / Auto / Manual	NO/NOy / Auto / Manual	NO/NOy / Auto / Manual
Temperature correction?	On / Off	On / Off	On / Off	On / Off	On / Off
Pressure correction?	On / Off	On / Off	On / Off	On / Off	On / Off
Diagnostic voltages					
PMT HV (Volts)					
+ 5 (Volts)					
+ 15 (Volts)					
- 15 (Volts)					
Diagnostic pressures					
Cell (mm Hg) (note: record 3 pressures)	/ /	/ /	/ /	/ /	/ /
Diagnostic temperatures					
Internal (C)					
Chamber (C)					
Cooler (C)					
NOy converter (C)					
NOy conv set (C)					
Diagnostic flows					
Ozonator (LPM) (note: record 3 flows)	/ /	/ /	/ /	/ /	/ /
Sample (LPM) (note: record 3 flows)	/ /	/ /	/ /	/ /	/ /
Maintenance					
Changed teflon filter?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Drierite date	/ /	/ /	/ /	/ /	/ /
Pink % / Changed?	/ Yes / No	/ Yes / No	/ Yes / No	/ Yes / No	/ Yes / No
Purafil date	/ /	/ /	/ /	/ /	/ /
Brown % / Changed?	/ Yes / No	/ Yes / No	/ Yes / No	/ Yes / No	/ Yes / No
Dry zero system date	/ /	/ /	/ /	/ /	/ /
NO cylinder					
ID / Conc (ppb)	/	/	/	/	/
Certification date					
Cylinder pressure (psi)					
NPN cylinder					
ID / Conc (ppb)	/	/	/	/	/
Certification date					
Cylinder pressure (psi)					
Instrument:	Thermo Environmental Instruments 42CY NOy Analyzer				

Worksheet:	Task 3 - Instrument checks and biweekly system audit (biweekly)	page 2
Site Code:		

Date	/ /	/ /	/ /	/ /	/ /
Field Tech					
Instrument SN					
BIWEEKLY CALIBRATION AUDIT:					
Dilution calibrator					
Model					
SN					
Calibration gases					
HNO_3 tube ID					
Dry zero					
Time on (PST) / Time off (PST)	/	/	/	/	/
Gas (ml/min) / Diluent (LPM)	/	/	/	/	/
Response NO (ppb) / NOy (ppb)	/	/	/	/	/
Low NO (prior to filter change)					
Time on (PST) / Time off (PST)	/	/	/	/	/
Gas (ml/min) / Diluent (LPM)	/	/	/	/	/
Response NO (ppb) / NOy (ppb)	/	/	/	/	/
Low NO (after to filter change)					
Time on (PST) / Time off (PST)	/	/	/	/	/
Gas (ml/min) / Diluent (LPM)	/	/	/	/	/
Response NO (ppb) / NOy (ppb)	/	/	/	/	/
High NO					
Time on (PST) / Time off (PST)	/	/	/	/	/
Gas (ml/min) / Diluent (LPM)	/	/	/	/	/
Response NO (ppb) / NOy (ppb)	/	/	/	/	/
NO2 (GPT)					
Time on (PST) / Time off (PST)	/	/	/	/	/
Gas (ml/min) / Diluent (LPM)	/	/	/	/	/
Response NO (ppb) / NOy (ppb)	/	/	/	/	/
NH3					
Time on (PST) / Time off (PST)	/	/	/	/	/
Response NO (ppb) / NOy (ppb)	/	/	/	/	/
HNO3 (with denuder)					
Time on (PST) / Time off (PST)	/	/	/	/	/
Gas (ml/min) / Diluent (LPM)	/	/	/	/	/
Response NO (ppb) / NOy (ppb)	/	/	/	/	/

Contact information:

CRPAQS Field Manager

Beth Wittig
Sonoma Technology, Inc.
Bakersfield Operations Center
2718 Ardee Circle
Bakersfield, CA 93304
(661) 837 - 4219
(661) 837 - 4219 fax
(661) 203 - 1082 cell
beth@sonomatech.com

NO_y Measurement Expert

Dennis Fitz
UC Riverside, CE-CERT
Riverside, CA
909 - 781 - 5781
909 - 781 - 5790
dfitz@cert.ucr.edu